Regional public support to airlines and airports: an unsolved puzzle

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Abstract

This paper proposes a structural model to explain the motivation of regional public authorities to arrange marketing agreements for route and traffic development. Furthermore, using data from Spanish airports, we empirically test this model obtaining the demand function according to the preferences of public authorities. The results show that the public budget, airport's attributes or intermodal competition affect to the demand for aircraft operations of regional public agencies. Finally, we propose an empirical method to determine the market power of airlines within these marketing agreements in a particular airport or route.

1 Introduction

In recent years, some airports have experienced a significant increase in air traffic due to the liberalization in the air transport market. In some cases, this phenomenon has been related to the existence of new transport policy tools which aim to promote the use of airport infrastructure with idle capacity. In this way, an increasing number of regional airports have received the support of their regional governments through financial arrangements with air carriers in order to open new routes, as well as to provide advertising services linked to the permanence of the air carrier at a given airport. Indeed, airport managers have more incentives to negotiate long-term contracts with air carriers in order to reduce the risk of traffic loss for their installations (Gillen, 2011).

In Europe, these types of agreements among regional governments and air carriers have been controversial, especially for those full service carriers (FSCs) which have made a claim to the European Commission, asking for these subsidies to be considered illegal. This has been the case of Charleroi airport and Ryanair (Barbot, 2006). In 2001, the Walloonian government, owner of Charleroi airport, signed an agreement with Ryanair in order to promote the use of the Charleroi facilities. Thus, the airport agreed to give a discount in landing fees and handling

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charges for a period of 15 years, among other measures, in exchange for Ryanair to commit itself to using Charleroi as an operating base for the same period. Three years later, the European Commission established that reductions in these fees and charges were partially incompatible with the common-market principles concerning state aids. The analysis and decision of the Charleroi-Ryanair case allowed the European Commission to develop guidelines on the financing of airports and start-up aids to airlines departing from regional airports in 2005. At the end of 2008, the European Court of First Instance annulled the Commission's Decision. In 2014 the Commission adopted new guidelines with the aim of adjusting to the new economic context (European Commission, 2014). In this sense, start-up aid to airlines will only be considered compatible for routes linking an airport with less than three million passengers per year and may cover up to 50% of airport charges of a route for a maximum period of three years. Additionally, for those connections which are already operated by a high-speed rail service or by another airport in the same catchment area, such air route will not be eligible for start-up aid.

In Spain, the Comisión Nacional de la Competencia ('*National Competition Commission*') issued a report about the public funds provided by regional public authorities to different airlines, with the aim of increasing the flow of travelers to certain destinations for the period 2007-2011 (CNC, 2011)[1]. The analysis focuses specifically on those marketing agreements concluded between public authorities and airlines. In this type of operations, the airline agrees to incorporate advertising for tourism purposes in different channels (on board magazine, webpage or promotional tickets) and also commits to opening new routes or maintaining those already available with origins or destinations in a certain airport. Meanwhile, the public authority agrees to pay for services rendered. As the report remarks, the price of the services included in the instruments used were determined from rates and average costs set by the airlines, although these rates have not been disclosed in the research (CNC, 2011; page 52).

Among the reasons why the CNC considers it relevant to study this type of public assistance are the increasing use of public support for the maintenance of routes at certain airports along with the potential distortion that can be generated in the allocation of productive factors. Finally, the report notes that the regional public authorities have not reported any such public support to the European Commission in any of the cases. This fact could reveal the perception of public agencies that this public support is not considered possible state aid, subject to the state aid general rules and the specific Community Guidelines on state aid to airports and airlines (2005).

The overall volume of public funds for the period 2007-2011 was nearly

[1] In October 2013, the Spanish government created the National Commission on Markets and Competition (CNMC in Spanish) from the merger of five agencies: the National Energy Commission (CNE), the Commission for the Telecommunications Market (CMT), the National Competition Commission (CNC), the National Commission for the Postal Sector and the Railway and Airport Regulatory Commission. The merge of the bodies was justified by the cost savings that this could generate for public finances.

250 million euros, concentrated in a few number of airlines. The distribution of public support was also not uniform across Spanish airports. Furthermore, the report showed that airports presented a negative correlation between their ratio of public funds per passenger and their corresponding traffic growth rates. From these results, one might ask how suitable this type of support is. A cost-benefit analysis of this public policy could determine whether the policy followed by numerous governments generates some kind of gains in terms of social welfare. However, this type of analysis is beyond the scope of this work due to its enormous complexity.

The literature related with regional public support to airlines and airports is recent and scarce. Barbot (2006) analyses the effects of subsidies for secondary airports on competition between low cost and full-scheduled carriers. This study also assesses a case study of the Ryanair-Charleroi airport agreement. The main results are that subsidization provokes a growth in demand, adding new users and a switch of passengers from full-scheduled carriers to low cost airlines. As far as the airport is concerned, the proposed model shows that the airport may benefit more from the arrangement than the subsidized air carrier, depending on its efficiency.

Malina et al. (2012) investigate incentive programs for route and traffic development at the 200 largest European airports in 2010. Two types of airport incentive schemes should be mentioned: *official incentive programs* and *bilateral agreements* between airports or regional authorities on one side and airlines on the other side. They find that the largest airports almost exclusively employ the published incentive programs, whereas small and medium-sized airports use both mechanisms. The authors argue that transaction costs could partially explain these facts. In this sense, larger airports could not bear the costs of negotiating bilateral agreements with different airlines, so the introduction of a dedicated incentive program might reduce these transaction costs. The descriptive study of Malina et al. (2012) do not study specifically the bilateral agreements due to the scarcity of official sources. However, they exemplified the Spanish case regarding the use of bilateral agreements between public authorities and airlines. Other descriptive studies which focus on this topic describe the evidence of German airports (Fichert and Klophaus, 2011), U.S. airports (Whittman, 2014) or European airports (Jones et al., 2013).

Allroggen et al. (2013) investigate determinants for offering incentives for the case of a sample of European airports. In this case, an empirical specification is proposed using a probit instrumental variable model with cross-sectional data. In order to justify the existence of these economic incentives, this paper shows that an airport authority calculates whether introducing incentives is economically viable by using the projected net present value of the incentives for route and traffic development. They demonstrate that airport competition, the importance of service sector, the economic regulation of airports, the existence of low cost traffic, the amount of charges, or the ownership structures have an impact on the presence of these incentives. In their conclusion, the authors point out the relevance of studies that focus on the existence of incentive programs at airports controlled by public entities in the debate on state aid and subsidization of airports within Europe.

Laurino and Beria (2014) discuss the main incentive schemes used by three Italian airports to attract airlines, which are often based on bilateral agreements rather than on transparent incentive programs. They focus on the common difficulties found related to the implementation of such tools and on the effects of these on the airport's financial results. The application of the 2005 EC Guidelines, the role of public entities in determining regional aviation policy or the risk of cannibalization among airports trying to attract airlines are the main topics studied by means of three case studies.

The literature on public service obligations in the air transport market also presents some connections with the different mechanisms of public support to airlines. In the Spanish context, some subsidies are granted to passengers living in the archipelagos of the Canary and Balearic Islands and also from passengers living in the Spanish autonomous cities of Ceuta and Melilla located in the north of Africa. Calzada and Fageda (2012) show that those routes with discounts for island residents have higher fares than on the rest of domestic routes. In this sense, these discounts might be working as a specific subsidy to airlines. Valido et al. (2014) demonstrate that air transport subsidies for resident passengers may produce inefficiencies in the market damaging the welfare of non-resident passengers. In this sense, they find that if the proportion of residents is high enough, non-resident passengers may be expelled from the market.

To our knowledge no previous theoretical or empirical study has examined the specific bilateral agreements between regional public authorities and airlines in any detail. The increasing importance of these types of incentive schemes in different countries as well as the controversy generated in relation to the common-market principles of the European legislation justify the need for a deeper analysis. The present paper intends to bridge this gap. In this paper we propose a structural model to explain the motivation of regional public authorities to arrange marketing agreements in order to attract new operators for their corresponding public airports. Such agreements are of special relevance in Spain (Malina et al., 2012), given the special features of the Spanish airport system in which a single public entity (Aena) manages the entire set of Spanish airports, weakening potential competition between them. Likewise, since we have annual public funding to increase the number of passengers for each airport it is possible to empirically test this model obtaining the demand function according to the expenditure preferences of public authorities. Finally, we propose a method to determine the market power of airlines within these marketing agreements in a particular airport or route. This measure may be particularly relevant in order to know which variables could explain the large variability of public funds in the bargaining process of marketing agreements between public authorities and airlines.

The paper is structured as follows. In Section 2 we describe the main features of the Spanish airport system. The theoretical model is presented in Section 3. Section 4 shows the econometric specification. The discussion of data is explained in Section 5. In Section 6 we discuss the econometric results. An application for the demand estimates in order to calculate the airline's bargaining power for marketing agreements with public authorities is presented in Section 7. Finally, in Section 8, we present the conclusions and policy implications regarding the public funds perceived by airlines.

2 The Spanish airport system

The Spanish airport system is managed by Aeropuertos Españoles y Navegación Aérea, Aena (‘*Spanish Airports and Air Navigation*’), a public-owned entity which owns and operates the most important airports in Spain, dependent on the Ministerio de Fomento (‘*Ministry of Development*’) since 1990. It is considered one of the main airport operators in the world, given that it manages 47 airports and 2 heliports in Spain and participates directly or indirectly in another 27 airports worldwide. Unlike other airport systems, the Spanish system has always been characterized by high centralization in the decision-making process through Aena, which manages all Spanish airports, barely taking into account their different characteristics. Thus, the funding mechanism of airport investments is made through a common fund, where no airport is accountable in terms of their operation and where cross-subsidies are present. In this sense, Bel and Fageda (2009) point to the existence of such subsidies mainly from specialized airports in tourist traffic to the major airport infrastructure. In this way, 14 of the Spanish airports presented operating profits, whereas 33 had operating losses.

This type of management is different from other transport infrastructure in Spain. This is the case of Spanish ports, whose reforms of 1992 and 1997 led to the decentralization of decision-making of each port authority with the participation of regional authorities on their boards, while they were forced to comply with the principle of financial self-sufficiency (Núñez-Sánchez, 2013).

Moreover, their pricing policy is uniform for the entire system and regulated by Law (Act 25/1998) given that airport charges are considered public fees. This regulation differentiates three types of airports depending on their levels of traffic in order to promote higher traffic level in those secondary airports. However, the annual update of these public fees is also uniform for every airport, so they do not necessarily correspond with costs. Another important feature of the Spanish airport system is the huge investment process which Aena implemented for the 2000-2010 period, more than eighteen thousand million euros, in order to increase the capacity of the incumbent commercial airports, as well as the creation of new ones in low-density population regions. This is the case of Burgos Airport (opened in 2008) or the Huesca-Pirineos Airport (considered commercial in 2000). One of the aims of the transport infrastructure policy of this decade is the promotion of regional development through investments in highways, airports and high-speed rail systems. This process left Aena with a total debt of fourteen thousand million euros.

In 2010, Act 13/2010 presented a new legal framework for the modernization and liberalization of the management of Spanish airports. The new rules aimed to transform the airport model into a more decentralized management system, increasing the private sector collaboration. In this way, the Law created a new firm Aena Aeropuertos (‘*Aena Airports*’), whose capital initially belonged to AENA, but provided the possibility of private capital inflows in the future.

Thus, in July 2011 the Council of Ministers approved the agreement authorizing the sale of shares of Aena Aeropuertos to a maximum of 49 percent of its share capital. At the same time, it authorized the creation of concession societies for the airports of Madrid-Barajas and Barcelona-El Prat in order to privatize 90 percent of their capital. The new regulation encouraged individualized management of airports by two alternative schemes: a) A concession of airport services, in which the concessionaire freely managed the airport at his own risk, or b) The creation of subsidiaries, which applied the same rules set for the firm Aena Aeropuertos.

However, in January 2012 the new elected government definitely canceled the auction for the concession of both airports given that the process of privatization was incompatible with its proposed airport management model. In this sense, the Minister of Transport acknowledged that the privatization of both airports would have generated competition between Madrid-Barajas and Barcelona El Prat, when the Ministry’s intention was that Spanish airports would compete with major global hubs. In this context and during the last few years, Spanish airports have not had any tools that would allow them to compete, trying to improve their number of routes and passenger volume. However, through different mechanisms, regional public authorities have tried to promote airport infrastructure located in its territory. This task has proven to be anything but simple as they cannot take part in decision-making processes regarding investments in capacity, quality or pricing[2].

Finally, in June 2014 the Spanish government approved partial privatization of Aena Aeropuertos, which will take place between February-March 2015. The Spanish government would maintain 51 percent of total shares and therefore control of the company. This model of privatization did not convince the Spanish regulatory agency, the Comisión Nacional de los Mercados y la Competencia (’*National Commission of Markets and Competition*’), which argued that the imposition of a public-private monopoly preserves the *status-quo* of airports but inhibits competition among airports.

3 Theoretical model

We consider a public agency that aims to promote the tourism sector in their region, which presents the following utility function:

$$U(Y, G) \tag{1}$$

where Y represents total aircraft movements in the airport located in its region and G represents the public expenditure in promotion of the tourism sector

[2] An interesting case study of the use of subsidies in the promotion of airport infrastructure is related by Bel (2009), for the case of Girona airport.

excluding those public funds for tourism purposes perceived by airlines. We consider that $\frac{\partial U(.)}{\partial Y} > 0$, $\frac{\partial U(.)}{\partial G} > 0$ and $\frac{\partial^2 U(.)}{\partial Y^2} < 0$, $\frac{\partial U^2(.)}{\partial G^2} < 0$. We assume that Y is distributed as:

$$Y(S) = \begin{cases} Y_0 & \text{if} \quad S = 0 \\ Y_0 + Y_S(S) & \text{if} \quad S > 0 \end{cases} \tag{2}$$

where Y_0 represents those aircraft movements in the airport which do not perceive any public fund that we call *natural aircraft movements* and $Y_S(S)$ the rest of aircraft movements which depend on the volume of public funds from marketing agreements between public authorities and airlines. We assume that $\frac{\partial Y_S(S)}{\partial S} > 0$ and $\frac{\partial^2 Y_S(S)}{\partial S^2} = 0$

$$Y_S = \alpha S, \alpha > 0 \tag{3}$$

Thus, the decision problem of the regional public authority is defined as:

$$\begin{aligned} &\underset{S,G}{max}\ U\left(Y(S), G\right) \\ &s.t. \quad S + G = B \end{aligned} \tag{4}$$

where B is defined as the total *public budget* of the regional public authority for the promotion of the tourism sector. Using equations 2 and 3, we may also express this budget constraint as:

$$G = \begin{cases} B & \text{if} \quad S = 0 \\ \left(B + \frac{Y_0}{\alpha}\right) - \frac{Y}{\alpha} & \text{if} \quad S > 0 \end{cases}$$

The budget constraint shows that public authority has to decide either to arrange marketing agreements with airlines or spend on other tourism-related activities. The equilibrium will be characterized by the pair (S^e, G^e) such that: $(S^e, G^e) = \max\left\{U\left(Y(S^*), G^*\right), U\left(Y(0), G^{**}\right)\right\}$, where (S^*, G^*) is the interior solution. Rearranging the FOC interior conditions of 4 we obtain that, for the case of $S > 0$, public agency should allocate its budget in order to fulfill the following condition:

$$MRS_Y^G = -\frac{dG}{dY} = \frac{\frac{\partial U(.)}{\partial Y}}{\frac{\partial U(.)}{\partial G}} = \frac{1}{\alpha} \quad \text{if} \quad S > 0 \tag{5}$$

otherwise:

$$MRS_Y^G = -\frac{dG}{dY} = \frac{\frac{\partial U(.)}{\partial Y}}{\frac{\partial U(.)}{\partial G}} = 0 \quad \text{if} \quad S = 0 \tag{6}$$

Figure 1 shows this argument geometrically. We observe the situation in which the optimal solution is $(Y(0), G^{**})$. In this case, the aircraft movements in the airport would be Y_0, and $G^{**} \equiv B$. From 4 we obtain the the *public expenditure function for marketing agreements* with airlines of the regional public agency,

$$S = S(Y_0, B) \tag{7}$$

This function specifies what the public agency would spend on marketing agreements with airlines for each *natural aircraft movements* and budget situation, assuming it perfectly solves the utility maximization problem. In order to improve its economic interpretation, we may rearrange equation 7 dividing both sides by Y,

$$s = s(Y_0, B, Y) \tag{8}$$

where $s = S/Y$ is the unit public funds, which is the ratio between public funds allocated for marketing agreements and total aircraft movements. We interpret this equation 8 as an "inverse demand function" for the public authority in the sense that expresses the maximum unit public fund that is willing to grant for a certain amount of additional aircraft movements, given the public budget and the *natural aircraft movements.* From this framework, we are able to obtain relevant information about how sensitive willingness to pay is in different situations and contexts for public authorities according to their preferences.

4 Econometric specification

4.1 Tobit models with exogenous regressors

As we have mentioned in previous sections, some public agencies do not grant any subsidy in order to increase aircraft movements in airports located in their region. So, the dependent variable of the specification 8, s, follows the next pattern:

$$s = \begin{cases} s^* & \text{if} \quad s^* > 0 \\ 0 & \text{if} \quad s^* \leq 0 \end{cases} \tag{9}$$

where s^* is considered as an unobserved latent variable. In this context, OLS estimation using censored data will lead to inconsistent estimation of the parameters. Then, we may use a Tobit model, which allows us to control our censored sample but requires the strong assumption about normality and homoskedasticity. The Tobit model is therefore often too restrictive in practice, especially for those variables which present skewness, as is the case of our variable of interest, s. However, we may circumvent this problem taking logs in our variable and considering as a lognormal where we observe (Cameron and Trivedi, 2005)

$$s = \begin{cases} s^* & \text{if} \quad \ln(s^*) > s_0 \\ 0 & \text{if} \quad \ln(s^*) \leq s_0 \end{cases} \tag{10}$$

where $s_0 \neq 0$.

Given that *natural aircraft movements,* Y_0 is not observable for the econometrician we consider $\mathbf{z}_1$ as the vector of the "reduced-form" variables that determine the value of Y_0. Take logs in 8 we have the following econometric relationship:

$$\ln(s) = \max[s_0, \mathbf{z}_1\boldsymbol{\delta}_{11} + \delta_{12}\ln(B) - \delta_{13}\ln(Y) + u_1] \tag{11}$$

4.2 Tobit models with endogenous regressors

Following Wooldridge (2002), we consider a type I Tobit model which includes Y as an endogenous explanatory variable. We consider the structural public agency demand model

$$\ln(Y) = \mathbf{z}_1\boldsymbol{\alpha}_{11} + \alpha_{12}\ln(B) + \mathbf{z}_2\boldsymbol{\alpha}_{13} + v_1 \tag{12}$$

$$\ln(s) = \max[s_0, \mathbf{z}_1\boldsymbol{\alpha}_{21} + \alpha_{22}\ln(B) - \alpha_{23}\ln(Y) + v_2] \tag{13}$$

where (v_1, v_2) are zero-mean normally distributed, independent of $\mathbf{z}$. If v_1 and v_2 are correlated, then Y is endogenous. Finally, we need that $\boldsymbol{\alpha}_{13} \neq 0$ in order to solve the identification problem.

5 Data and description

5.1 Data

Our analysis uses the results of the survey carried out by CNC (2011), which focus on those actions of administrations and public agencies in order to increase the flow of passengers to certain destinations from 2007 until 2011. Among them, we find public funds which were granted to airlines for opening new routes or financial arrangements aimed at the provision of advertising or tourism promotion services by the airline in exchange for their permanence at a particular airport for a certain period of time[3]. To collect this information, the CNC sent a questionnaire to all regional public authorities, Aena, the Tourism Institute of Spain (Turespaña) and those airlines with more than five million passengers per year in 2010 (Iberia traffic, Ryanair, Air Europa, Spanair, Air Nostrum, Vueling, EasyJet and AirBerlin). Additionally, the CNC required all financial agreements whose main objective had been advertising or tourism promotion to be carried out by the airlines. Public agencies and airlines signed 124 bilateral agreements from 2007 to April 2011. As we see in Figure 2 more than half of the contracts were for an amount below half a million euros while sixteen contracts exceeded two million euros.

Potential beneficiaries of public funds arising from these contracts and agreements are the airlines directly, and airports, indirectly. Regarding airlines, the emergence of low cost airlines in the early twenty-first century brought new opportunities for those regional airports, reducing ticket prices and generating a change in the structure of the aviation market. However, as pointed out by the CNC in its report Air Nostrum, a franchise company of regional Iberia flights, is the largest recipient of such funds. Second, Ryanair gets an increasing amount

[3]As remarks the Comisión Nacional de la Competencia, given that none of these public agencies have notified the European Commission in order to enforce the State Aid Rules and the Guidelines, they probably do not consider them a public aid. However, the opening of investigations by the European Commission in some airports in different European countries (France, Germany or Romania) make the study of such subsidies in the Spanish case relevant.

of public funds. Third, Lagunair that went bankrupt in 2009 and fourth, the low-cost carrier Vueling.

As regards airports, they benefit indirectly from such public funds to increase the number of routes or frequencies of the existing ones. Zaragoza, León, Santander, Valladolid or Burgos were the main beneficiaries; all of them considered secondary regional airports given that all of them carried a lot less than 1.5 million passengers per year. In this way, some regional agencies from Castilla y León (84 million euros), Aragón (34 million euros), Galicia (23 million euros) or Cantabria (21 million euros) distributed public funds worth over 20 million euros for the period 2007-2011. On the other hand, carriers which operated in Barcelona, Bilbao, Granada-Jaén, Jerez, Sevilla and Vitoria did not receive any public funds. Other administrations have not considered it relevant to reach agreements with carriers in order to tie some airlines to the airports located in their regions. This is the case of Navarra (0.55 million Euros), Madrid (0.52 million euros) or Andalucía (0.19 million euros) (Figure 3). In this way, we observe that some of the most important Spanish airports do not benefit from these agreements. As the CNC (2011) mentions, public funds increased for the period 2007-2011. In this way, in 2007 almost 30 million euros were granted to airlines, whereas in 2009 the total amount came to 62.5 million euros.

A summary of the public funds and some characteristics of the Spanish airports is presented in Table 1. Regarding results, only 11 airports presented positive operating profits for the period 2007-2011 (Alicante, Bilbao, Fuerteventura, Girona, Ibiza, Lanzarote, Gran Canaria, Palma de Mallorca, Tenerife Sur, Sevilla and Valencia). Most of these airports are specialized in tourism with passenger levels higher than 4 million passengers. Within this group, just Girona (1.04 million euros), Alicante (1.64 million euros) and Valencia (1.64 million euros) presented significant public support, with a significant presence of low-cost carriers. Furthermore, the two airports less specialized in tourism, Bilbao and Sevilla, did not indirectly perceive any public funds. Regarding the two largest Spanish airports, Madrid and Barcelona, both showed negative operating profits despite the number of passengers involved. On the other hand, the main beneficiaries of public funds (Zaragoza, León, Santander, Salamanca, Valladolid or Burgos) generated signicant operating losses due to the low number of passengers concerned, less than 1 million passengers per year. All of them are located in cities or provinces in which tourism is not an important economic sector. Another group of airports with low level of passengers and significant amount of public funds are: Albacete (1.44 million euros), Badajoz (1.87 million euros), Logroño (0.72 million euros) and Melilla (0.72 million euros). Finally, we find several airports that handle between 1 and 2.5 million passengers per year, most of them located in northerm Spain, which experience moderate operating losses (Asturias, A Coruña, Santiago and Vigo).

5.2 Variables

In our econometric specification the dependent variable is the unit public funds granted by public authorities to airlines. Unfortunately, the CNC report does not provide data disaggregated by airline, so we just observe those aggregated public funds by airport[4]. As we mentioned in previous sections, the *unit subsidy* (s) is calculated as the total amount of public funds by airport over the total aircraft movements in the airport (Y). This variable was obtained from the report of CNC (2011) and the statistical service of Aena[5].

Regarding the explanatory variables, the variable *public budget* (B) is defined as the total public budget of the public authority for the promotion of the tourism sector but also the promotion of retailing activities and the small and medium-sized enterprises (SME). It was collected from the general budgets of the corresponding regions[6]. The unavailability of more disaggregated statistics for each region prevented us considering a variable that only collects the public promotion of the tourism sector. However, the use of official statistics from the Ministry of Finance and Public Administration allows the information to be homogeneous across regions.

Additionally, as we mentioned in Section 4.1 the variable *natural aircraft movements,* Y_0 is not observable for the econometrician, so we considered $\mathbf{z}_1$ as the vector of the "reduced-form" variables that determined the value of Y_0.

$$\mathbf{z}_1 = (pop, dist, isl, low\cos t, motway, railway, eind, tourism, Mad, BCN) \tag{14}$$

The first variable refers to the *population* (*pop*), which is defined as the total population of the province where the airport is located (INE, 2013). This variable might capture the size of their catchment area. While it seems clear that there is a positive effect of the size of the airport's catchment area on its natural traffic, in the case of unit subsidy the effect is not clear.

The variable *distance* (*dist*) shows the distance of the nearest airport, expressed in kilometers. Two, or more, airports might compete if they share a local market. The existence of overlapping catchment areas of different airports might induce greater competition. Thus, airports might establish either incentives to airlines for route and traffic development or bilateral agreements with airlines (Malina et al., 2012). We have also included a dummy variable island (*isl*) which captures whether the airport is located on an island or not.

The following variable refers to the *percentage of passengers* that uses *low-cost carriers* (*lowcost*). To construct this variable, we collected the total number of passengers handled by the low-cost carriers for every individual airport[7]. We

[4]In some cases, tourism promotion contracts between public agencies and airlines did not link this promotion of the use of a particular airport. Therefore, for regions with multiple airports, which was not specified which ones were the beneficiaries, the amount of the agreements have been distributed uniformly (CNC, 2011).

[5]The statistical data about air traffic in the Aena's airports can be consulted at: http://www.aena.es/csee/Satellite?pagename=Estadisticas/Home.

[6]The Spanish Public Administration Ministry provides detailed information about the different regional general budgets in the following link: http://serviciosweb.meh.es/apps/publicacionpresupuestos/aspx/inicio.aspx. We have used the account 43 that refers to Retailing, Tourism and SME.

[7]We considered the following airlines as low-cost carriers: Ryanair, EasyJet, Norwegian, Vueling, Clickair, BMI Baby, WizzAir, Air Lingus, Air Baltic, Jet2.com, AirBerlin, Condor, Monarch Airlines, Meridiana, Cimber, Volare Airlines, Myair, Transavia, Flybe, BMIBaby,

use this variable as nominator and the total number of passengers as denominator. Then, we proceeded to calculate the respective fraction. The expected relationship between this variable and the unit subsidy would be positive for several reasons. First, because the use of low-cost carriers has increased in recent years. Second, these airlines often offer cheaper fares than other companies. Therefore, the most important target for these airlines is leisure passengers, whose demand is more elastic.

Other important variables related with the *natural aircraft movements* are those related with the intensity of intermodal competition. We have considered the following variables: the *density of motorways* (*motway*) and the *density of railways* (*railway*) of the region where the airport is located. Both variables are defined as the total kilometers of motorways and railways, respectively divided by the total area of the region, expressed in 100km^2. They were obtained from the Instituto Nacional de Estadística ('*National Statistics Institute'*) and Ministerio de Fomento ('*Ministry of Development*'), respectively. The existence of intermodal transport infrastructures might reduce the willingness to grant a certain amount of additional aircraft movements.

The variable regional industrial specialization index (*eind*) tries to capture the sectorial specialization of the airport's region[8]. In this case, a more attractive catchment area, in terms of business passengers, might have influence on the unit subsidy s. Additionally, a variable related to the tourism intensity of the airport's province (*tourism*) has been included[9]. That index is based on the tax rate applied to tourism activities. Its value reflects the relative weight of tourism on a single region compared to Spain. As we saw in the descriptive analysis presented in the previous section we noted that the effect of this variable on the unit public funds is unclear. On the one hand, there is a group of airports in specialized provinces in the tourism sector benefiting from public funds. But on the other hand, the largest recipients were secondary airports.

Finally, we have also considered the distances between the city in which the airport is located and the largest Spanish cities: Madrid (Mad) and Barcelona (BCN), which concentrates most of the flights in the Spanish secondary airports. We expected that higher distances to these cities might increase the sensitivity of unit public funds.

Table 2 shows the main summary statistics for these variables[10].

Thomsonfly, German Wings, Hapag Lloyd Express, FlyBaboo and BlueAir.

[8]The regional industrial specialization index shows the relative importance (in terms of GDP) of the industrial sector in a region in relation with the total country. If we consider a national economy with H regions (h=1,...,H) and K sectors (k=1,...,K) this index $eind_{ij}$ for the region i in the particular sector j is defined as:

$$eind_{ij} = \frac{\frac{GDP_{ij}}{\sum_k GDP_{ik}}}{\frac{\sum_j GDP_{hj}}{\sum_k \sum_k GDP_{hk}}}$$

[9]The tourism index comes from the Economic Yearbook of Spain published by la Caixa, available on its website: http://www.anuarioeco.lacaixa.comunicacions.com/

[10]As we mentioned in previous sections, Aena manages 47 airports and 2 heliports in Spain.

6 Econometric results

Table 3 shows the results obtained for different specifications of the Tobit model presented in Section 4. Specification (1) shows a standard Tobit model whereas in specification (2) and (3) consider the possibility of endogenous regressors. In particular, in specification (2) we treat the variable aircraft movements, Y, as an endogenous explanatory variable. The set of instruments used for this variable are related with the fees paid to the airports and a measure of terminal productivity (*product*), which is defined as the total passengers handled divided by the area of the passenger's terminal. Given that the actual fees are not observable for each airport, we proxy them by using dummy variables, which capture the different categories of Spanish airports. Until 2011, Spanish regulation considered three categories of airports. Every category (First category: $ac1$; Second category: $ac2$; Third category: $ac3$) has its own fees. Finally, in specification (3) we also treat the variables *lowcost* and *tourism* as an endogenous variables. Thus, we choose one-period lag values of the percentage of passengers that uses low-cost carriers and tourism intensity of the airport's province as explanatory variables, using the same framework of Allroggen et al. (2013). The parametric (MLE) estimation method of specification (2) and (3) assumes that the structural (Eq.13) and reduced-form (Eq.12) equation errors are jointly normally distributed. The results are consistent for all the specifications. In these specifications we also present a Wald test of exogeneity. In this case, we reject the null hypothesis of exogeneity so the use of an instrumental variable Tobit approach is justified. Moreover, the Hansen's J test of the possible endogeneity of the instruments is provided in order to test the validity of the instruments. In specifications (2) and (3) the J statistics are 0.55 and 0.37, respectively (p-values 0.76 and 0.83) so we cannot reject the null hypothesis of exogeneity of the instruments, that is $E\left(z_2 v_2\right) = 0$. Thus, we demonstrate the validity of the instruments.

The variable *total aircraft movements* (Y) is highly significant and presents a negative sign, supporting the downward sloping of the "inverse demand curve" for public authorities. The coefficient of the variable *public budget* (B) of public authorities is also negative and statistically different to zero. This result shows the negative relationship between the total amount of public budget and the unit public funds perceived for airlines in a particular airport. Thus, those airports located in regions with higher public budgets present lower unit subsidies. This result suggests that those regions with high specialization in the tourism sector do not use these type of contracts and agreements in order to increase the flow of passengers if we compare them with other less-specialized regions. Additionally, considering the theoretical model developed in previous sections we may interpret that public agencies consider the existence of additional aircraft movements as an *inferior good*.

Regarding the variables *population* (*pop*) and *distance* (*dist*), they are both

However, a significant number of them do not have commercial flights. This is the case of *Ceuta*, *Córdoba*, *Cuatro Vientos*, *Huesca-Pirineos*, *Torrejón*, *Sabadell* and *Son Bonet*. In our analysis, we have not included them in order to mantain homogeneity in our sample.

positive and statistically significant. This suggests that airports with larger influence areas (with the possibility of the existence of *density economics*) benefit from servicing airlines which receive higher unit public funds. The positive coefficient related to *distance* supports the idea that public authorities do not consider granting these contracts to be the way to increase competition among nearer airports. This latter finding is consistent with the results of Allroggen et al. (2013) for European airports, which shows that airports are less likely to introduce incentives for route development if they face higher competition from other airports.

On the other hand, the dummy variable for airports located on *islands* (*isl*) is negative and statistically significant, so we might interpret that the island public authorities do not consider it to be necessary to provide public funds in order to attract traffic. It could be possible that the existence of mechanisms of public service obligations considered as a sort of specific subsidy to airlines (Calzada and Fageda, 2012) had some influence on this result.

We also observe the positive relationship between the percentage of passengers that use low-cost carriers and higher unit subsidies. This result is similar to the findings reported by Allroggen et al. (2013), which show that those airports with a positive management attitude towards potential profits from low-cost traffic (especially from Ryanair's passengers) present higher probability of the presence of incentives. Other authors such as Bel and Fageda (2010), consider that low-cost airlines have a greater negotiating capacity than other airlines. Given that *lowcost* might be endogenous, we have considered different specifications for the model.

In the case of variables related to intermodal competition, both variables *motway* and *railway* have the expected signs but just the density of motorways is statistically significant in all of the specifications. This result shows the importance of competition between different modes, in this case, road and air transport.

Additionally, the unit public subsidies are higher in the case of regions more specialized in the *industry sector* (*eind*). Then, we might consider the attractiveness of the catchment area as a relevant factor to explain the importance of bilateral agreements between public authorities and airlines. However, we have not found any significant relationship between *tourism intensity* (*tourism*) and public subsidies. This finding might be explained by the fact that, in many of these agreements there are clauses that do not seem to be linked to the objective of promoting one or more destinations, but respond to other purposes. In this sense, the report of the CNC (2011) shows that one of these aspects are the requirements and conditions imposed on airlines, in terms of completion of a minimum number of destinations from a particular airport.

Although the distance between the city in which the airport is located and Madrid or Barcelona is positively related with higher unit subsidies, this estimated effect is not statistically significant at 5%.

Last, we have included both temporal dummies and regional dummies in order to capture unobservable effects[11].

In order to check the sensitivity for the elasticity of the aircraft movements demand for public authorities, Table 4 reports different elasticity measures for the specification (2) using different values of some relevant variables such as: *total aircraft movements* (Y), *public budget* (B), *population* (*pop*), *percentage of low-cost passengers* (*lowcost*), *density of motorways* (*motway*) and the *industrial specialization index* (*eind*). Regarding the elasticity of this variable $\varepsilon_{s,Y} = \frac{\partial s}{\partial Y}\frac{Y}{s}$, results show a negative relationship between the sensitivity of unit public funds and size (in terms of aircraft movements) of the airport. The sensitivity of unit subsidies of regional public agencies is larger when the size of the airport is smaller. So, public authorities are willing to grant higher unit subsidies in order to retain aircraft movements as the size of the airport decreases. This result seems logical, given that in some of the smaller Spanish airports, just one airline operates. This is the case of *Badajoz*, *Burgos*, or *La Rioja*, in which only the company *Air Nostrum* provides flights. There is exists also a negative relationship between the elasticity of unit subsidies, $\varepsilon_{s,Y}$, and the public budget or the density of motorways in the region in which the airport is located. Thus, the sensitivity of unit subsidies is larger when public budget or density of motorways is smaller. It is specially interesting to observe the high sensitivity of the elasticity with relation to the different values of the density of motorways.

On the other hand, population, percentage of low-cost passengers and the specialization in the industry sector present a negative relationship with the elasticity of unit subsidies, $\varepsilon_{s,Y}$. Calculating the inverse of this variable, we obtain $\varepsilon_{Y,s} = \frac{\partial Y}{\partial s}\frac{s}{Y}$, the elasticity of the aircraft movements demand for public authorities.

7 Application of the demand estimates

We have specified the inverse demand estimation procedure and elasticity estimates which can be useful for the economic analysis of public funds perceived by airlines. We now consider a possible application in order to use these estimates.We propose an oligopoly model *à la Cournot* in which airlines set capacities simultaneously in a certain route or airport.

We consider the decision-making problem of the first stage for an airline which operates in a particular route or airport and perceives public funds from a marketing agreement. In the second stage, the airline would decide fares once it has installed capacity in a particular route or airport. In this application we do not consider this second stage due to the limitations of data concerned to public funds. We demonstrate that it is relevant to gather information about the elasticity of demand, in order to determine the market power of the airlines in the bargaining process of marketing agreements between public authorities and airlines. This model may be tested either in a particular route or airport. First, we define the decision-making problem of an airline as

[11] Coefficient related to temporal and regional dummies are also available on request.

$$\underset{y_i}{max}\ \Pi\left(y_i, y_{-i}\right) \equiv s\left(Y\right) y_i - C_i\left(y_i\right)$$

where y_i is the aircraft operations of the carrier i, y_{-i} is defined as the aircraft operations of other carriers in the same route or airport and $s\left(Y\right)$ expreses the inverse demand function of public authorities, which we defined.in Section 3.

The first-order condition of profit maximization is

$$\frac{\partial s(Y)}{\partial Y}\frac{\partial Y}{\partial y_i}y_i + s(Y) - \frac{\partial C_i(q_i)}{\partial y_i} = 0 \tag{15}$$

After some arrangements, we can rewrite 15 as

$$s(Y)\left(1 - \frac{\alpha_i}{\varepsilon_{Y,s}}\right) = c_i' \tag{16}$$

where $\alpha_i = \frac{y_i}{Y}$ is defined as the market share of airline i. We can also express the equation 16 as

$$\frac{s(Y) - c_i'}{s(Y)} = -\frac{\alpha_i}{\varepsilon_{Y,s}} \tag{17}$$

where $\alpha_i = \frac{y_i}{Y}$ is defined as the market share of airline i. Hence, this model predicts that in a given market, a larger airline should have a larger markup. If we weigh up airlines by their market shares, we obtain the following expression

$$s(Y)\left(\alpha_i - \frac{\alpha_i^2}{\varepsilon_{Y,s}}\right) = \alpha_i c_i' \tag{18}$$

Next, we aggregate the first-order conditions for all the airlines

$$s(Y)\left(1 - \frac{H}{\varepsilon_{Y,s}}\right) = \sum_{i=1}^{N}\alpha_i c_i' \tag{19}$$

where $H = \sum\limits_{i=1}^{N}\alpha_i^2$ is defined as *Herfindahl index*, which measures the degree of concentration of the airlines in a particular route or airport. Re-arranging

$$\frac{s(Y) - \sum\limits_{i=1}^{N}\alpha_i c_i'}{s(Y)} = -\frac{H}{\varepsilon_{Y,s}} \tag{20}$$

We conclude that the average *Lerner index* is proportional to the Herfindahl index. Then, calculating the Herfindahl index and estimating the public funds elasticity of demand allows for calculation of the average markup in a particular route or airport. Equation 20 also allows us to evaluate the existence of a monopoly in a particular airport or route, given that in that case, the *Herfindahl index* would be equal to one. Therefore, the Lerner index in this case would be inversely proportional to the elasticy of the public authority demand. Therefore, first we have calculated the Herfindahl index using data from statistics of Aena website, given the availability of the airlines' market shares for each airport. Secondly, we have estimated the individual elasticity $\varepsilon_{Y,s}$ for each airport at the mean values of the different explanatory variables of our estimated model. Thus, using equation 20 we estimate the average bargaining power of airlines.

Table 5 reports the average mark-up for airlines which perceives public funds in the Spanish airports for the period 2007-2011. These estimates ranges from the minimum value, 0.0015 but not statistically different from zero, which corresponds to *Málaga* to the maximum value, 3.4, of *La Gomera*. Other airports which present significant high markups of airlines are: *Girona* (2.2), *El Hierro* (2.58), *Reus, Murcia* (2.35) or *Melilla* (3.28) In these airports the Herfindahl index shows the existence of only one air carrier, with the exception of *Murcia*. In the case of *La Gomera*, the regional air carrier *Binter Canarias* is the monopolist which just operates in inter-islands flights between the different Canary Islands. For the Catalonian airports of *Girona* and *Reus* it is *Ryanair,* the only air carrier that operates with regular flights. Furthermore, both airports are considered operating bases for *Ryanair*[12] Finally, in *Melilla,* located in Northern Africa, the only company which operates is *Air Nostrum*. Regarding those airports which present low average mark-up of their air carriers, they present similar characteristics, given that all of them are located in important tourism destinations of the Mediterranean Sea and the Canary Islands. This is the case of *Alicante* (0.31), *Lanzarote* (0.33), *Fuerteventura* (0.34), *Tenerife Sur* (0.3) or *Gran Canaria* (0.34).

Finally, in Figure 4 we plot air carrier's mark-up for every airport and their size in terms of aircraft movements. We demonstrate the negative relationship between the bargaining power of airlines and the size of the airport.

8 Conclusions

In this analysis, we propose a structural model to evaluate the motivation of regional public authorities to arrange marketing agreements for route and traffic development in their corresponding airports. Then, we empirically test the model using a tobit instrumental variable approach in order to assess factors that may affect the willingness of public funds that public authorities grant. We demonstrate that: the inverse demand curve for public authorities is downward sloping, the negative relationship between the total amount of the public budget and the unit public fund, and the influence of external factors such as: the population of the catchment area, the distance of the nearest airport, variables related to intermodal competition, location of the airport or the importance of

[12] The bargaining power of Ryanair was demonstrated in 2011 when the company threatened to withdraw its base at Reus airport, after demanding 15 million euros from the regional government to continue on that infrastructure. For its part, the government of Catalonia was willing to pay 7.5 million euros. Finally, given the impossibility of an agreement, Ryanair reduced from 30 to just 6 destinations in this airport for 2012.

low-cost passengers.

Additionally, we observe that the sensitivity of demand for aircraft operations of regional public agencies increases as the size of the airport also increases. Finally, we present an application of the proposed model to evaluate the market power of airlines within these marketing agreements in a particular airport or route, using the estimates of elasticity of demand and the Herfindahl indexes in a particular route or airport. The results show that those airports considered as operating bases for a particular airline (*Reus*, *Girona*) and those located a in low population territory (*La Gomera*, *Melilla*) present the highest airline's mark-ups, whereas the lowest mark-ups correspond to those airports located in the most important touristic destinations in the Mediterranean Sea and Canary Islands (*Alicante*, *Lanzarote*, *Fuerteventura*, *Tenerife Sur*, *Cran Canaria*). These airports present operating profits and they are specialized in leisure passengers with a strong presence of low-cost and charter carriers. We believe that this methodology and the empirical results presented in this manuscript may be used either for regional public authorities, airlines, airport managers or even the competition commission in the ex-ante or ex-post evaluation of the bilateral agreements for route and traffic development.

We also want to highlight some limitations in this study. While we appreciate the efforts made by the CNC to gather information from the public funds allocated to the airlines on tourism oriented marketing agreements, we believe that the distribution of the funds for each route and airline should also be available. Thus, it would be possible to determine the relationship between public funds, the power of the carriers when negotiating the granting of public funds and finally the market power in the provision of air service. The lack of this information has only allowed us to estimate the average degree of market power at each airport, which may be a first approach for future work on this topic.

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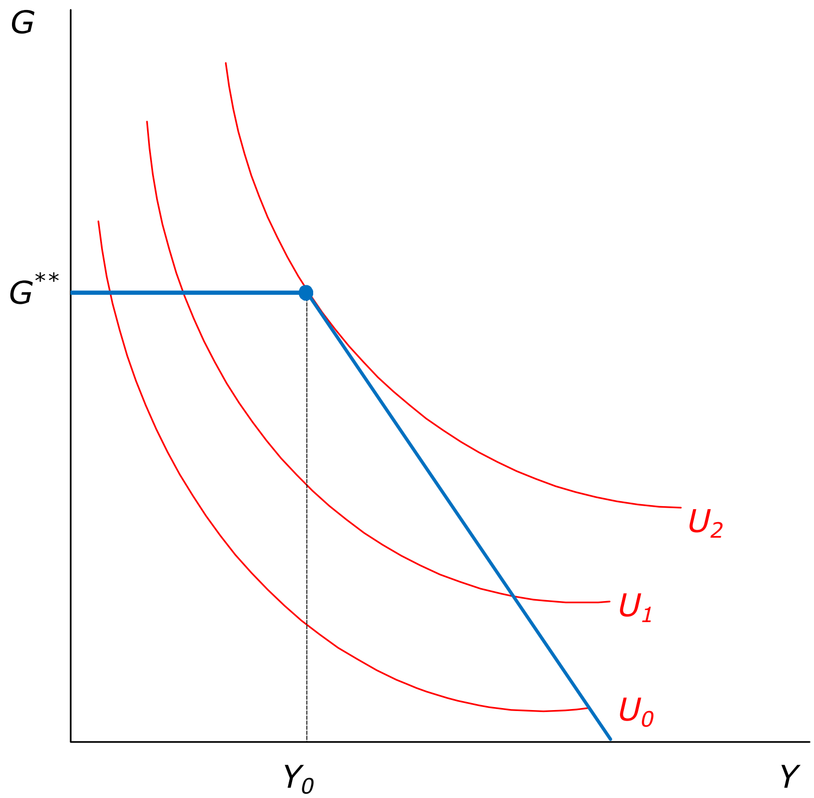

Figure 1: Equilibrium for a public agency with no subsidies

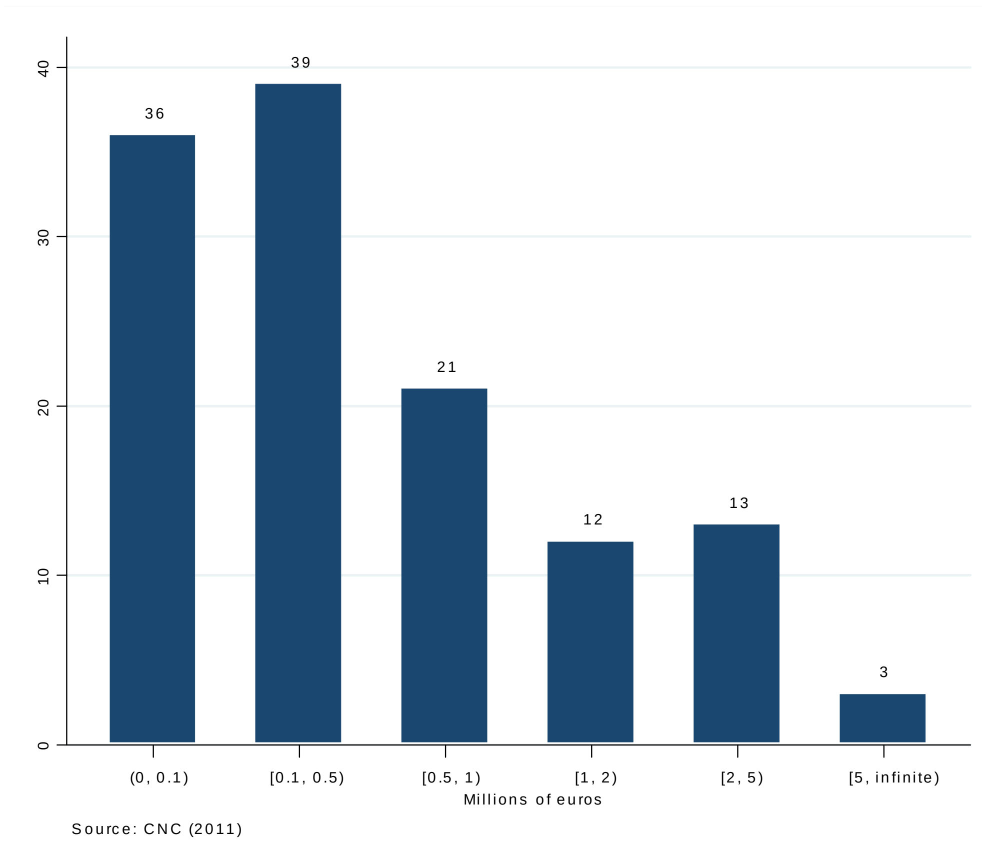

Figure 2: Distribution of bilateral agreements by economic value

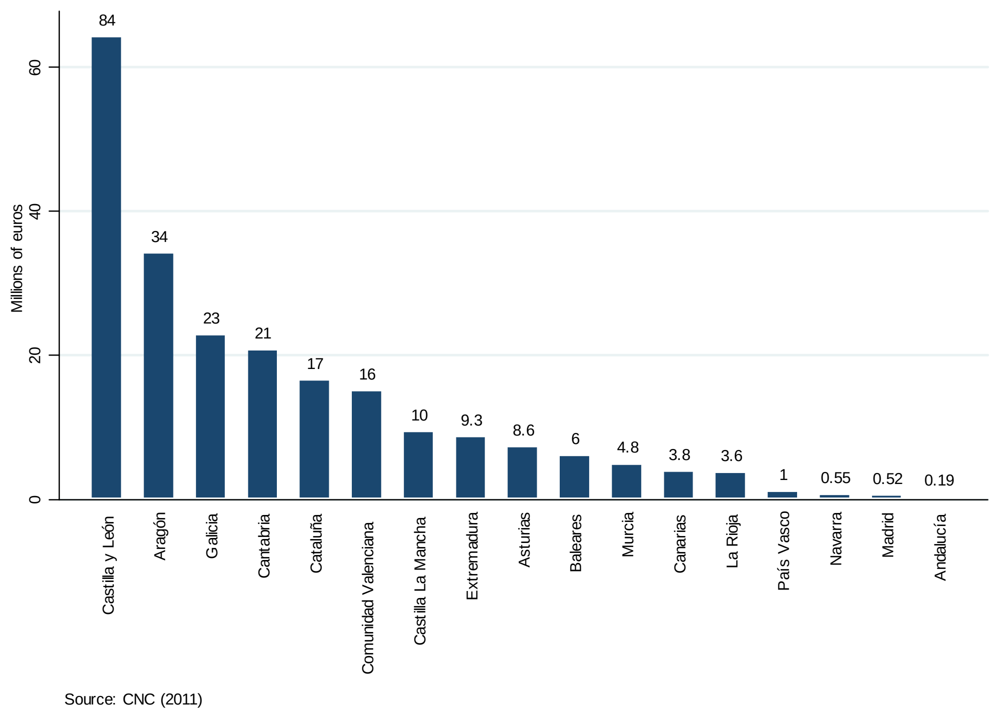

Figure 3: Distribution of regional public funds allocated to agreements for the period 2007-2011

Table 1: Mean of public funds and characteristics of the Spanish airports (2007-2011)

Airport	aid mill €	pas mill	cargo mill	lowcost perc	inc €/pas	exp €/pas	prod pas/sq mt	tour
Albacete	1.44	0.01	0.00	0.00	14.28	270.42	6.72	230
Alicante	1.64	9.43	3.97	0.81	10.35	7.42	175.86	5,068
Almería	0.01	0.92	0.02	0.55	11.02	20.69	36.87	1,959
Asturias	1.72	1.42	0.14	0.27	9.22	11.69	81.62	1,436
Badajoz	1.87	0.07	0.00	0.00	10.94	44.80	16.60	422
Barcelona	0.00	30.80	98.30	0.43	11.84	12.67	43.85	9,321
Bilbao	0.00	4.01	2.86	0.31	10.90	9.44	79.31	753
Burgos	4.04	0.02	0.00	0.00	8.15	168.43	9.44	462
A Coruña	2.68	1.12	0.26	0.24	9.62	15.07	86.13	1,358
Fuerteventura	0.03	4.40	2.21	0.51	8.97	8.63	47.28	9,088
Girona	1.04	4.70	0.12	0.99	7.87	6.22	156.79	3,040
Granada-Jaén	0.00	1.19	0.05	0.48	8.57	14.44	140.02	1,701
Hierro	0.03	0.18	0.16	0.00	5.46	38.72	70.62	7,624
Ibiza	0.45	4.93	3.43	0.64	7.76	7.57	135.17	13,006
Jerez	0.00	1.21	0.10	0.52	10.59	19.50	75.33	2,902
Lanzarote	0.11	5.25	4.40	0.46	8.35	7.26	89.59	9,088
La Palma	0.08	1.09	1.11	0.16	6.88	20.24	102.47	7,624
Logroño	0.72	0.04	0.00	0.01	16.18	255.49	9.11	328
La Gomera	0.03	0.04	0.01	0.00	16.88	161.77	11.98	7,624
León	4.73	0.11	0.01	0.00	11.75	74.89	12.56	567
Gran Canaria	0.10	9.95	29.10	0.39	8.77	7.15	90.78	9,088
Madrid	0.11	50.20	345.00	0.18	13.17	13.93	50.62	10,523
Menorca	0.32	2.58	2.80	0.43	8.35	13.12	128.63	13,006
Málaga	0.03	12.60	4.02	0.73	10.86	11.24	31.64	6,909
Melilla	0.72	0.31	0.36	0.00	5.71	37.04	166.25	43
Palma de Mallorca	0.43	22.20	18.90	0.75	8.49	6.43	101.01	13,006
Pamplona	0.11	0.36	0.04	0.00	9.32	33.63	29.03	825
Reus	1.95	1.41	0.08	1.00	7.57	11.81	109.51	2,718
Salamanca	4.04	0.05	0.00	0.00	14.24	103.82	12.95	580
Murcia	0.96	1.62	0.00	0.92	8.74	9.29	127.38	1,469
San Sebastián	0.09	0.34	0.08	0.00	9.31	27.56	125.30	636
Tenerife Sur	0.26	8.00	6.46	0.75	10.43	8.19	93.71	7,624
Tenerife Norte	0.14	4.11	19.20	0.07	7.01	8.35	76.67	7,624
Santander	4.13	0.92	0.01	0.62	7.60	12.10	45.22	1,068
Santiago	1.33	2.11	2.18	0.52	9.66	12.56	112.50	1,358
Sevilla	0.00	4.43	5.82	0.65	9.89	9.54	71.43	2,881
Valencia	1.64	5.28	11.70	0.54	10.92	9.51	141.61	2,897
Valladolid	4.04	0.44	0.04	0.62	8.32	19.88	98.37	507
Vigo	0.53	1.17	1.25	0.12	9.57	17.98	149.87	1,068
Vitoria	0.12	0.07	31.30	0.13	85.60	435.56	12.11	471
Zaragoza	6.81	0.60	33.90	0.69	11.28	22.96	36.83	1,016
Total	1.15	4.76	15.10	0.37	14.19	48.95	76.21	4,034

aid: public funds; pas: total passengers; cargo: total cargo; lowcost: percentage of low-cost passengers
inc: total income; exp: total expenditures; prod: productivity of terminals; tour: tourism index (La Caixa)

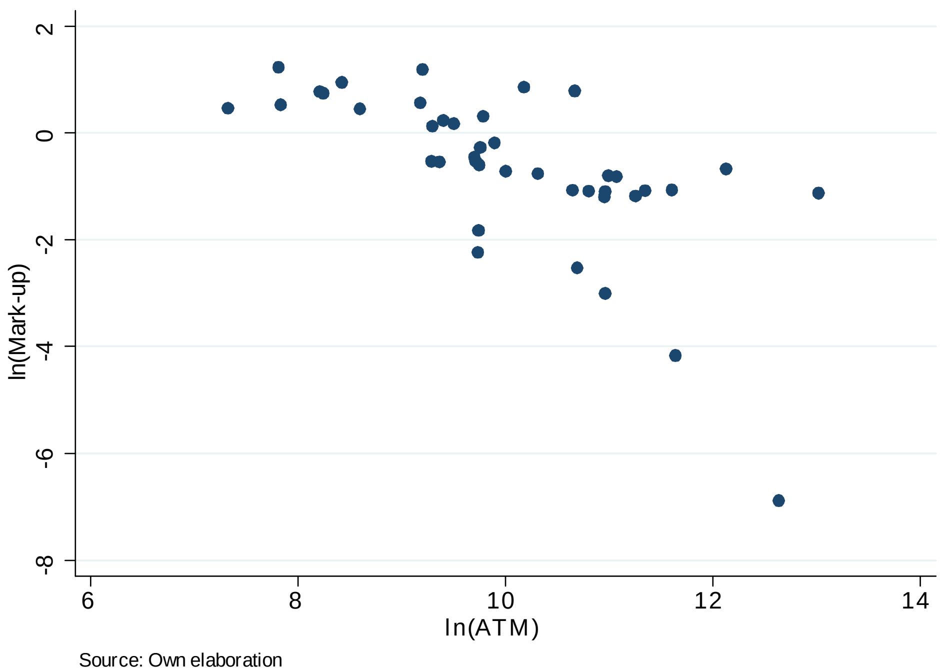

Figure 4: Relationship between aircraft movements (ATM) and airline's mark-ups

Table 2: Summary statistics of the variables

	Units of measure	Mean	Std. Dev.	Min	Max
Unit subsidy (s)	Euros per aircraft	152.7	391.8	0	3,061.9
Aircraft movements (Y)		50,987	83,943	937	483,292
Tourism-oriented budget (B)	Million Euros	162.7	236.2	7.4	1,061.1
Population (pop)	Inhabitants	1,273,182	1,673,589	10,558	6,458,684
Minimum distance of airports ($dist$)	Kilometers	86.8	35.9	24	183
Island (isl)		0.29	0.45	0	1
Lowcost ($lowcost$)	Percentage	0.37	0.32	0	1
Terminal productivity ($product$)	Pass/sq. met	76.56	51.09	0	184.94
Density of motorways ($motway$)	km/100km^2	3.25	1.77	0	9.71
Density of railway ($railway$)	km/100km^2	3.10	2.59	0	9.03
Tourism index ($tourism$)		4,050.51	4,097.97	32	14,376
Industrial specialization index ($eind$)		0.91	0.57	0.11	2.47
Distance to Madrid (Mad)	Kilometers	705.11	557.85	0	2258
Distance to Barcelona (BCN)	Kilometers	951.01	731.6	0	2712
Airport category: First ($ac1$)		0.27	0.44	0	1
Airport category: Second ($ac2$)		0.25	0.43	0	1
Airport category: Third ($ac3$)		0.48	0.5	0	1
Herfindahl index (H)		0.392	0.329	0	1

Table 3: Estimates of the inverse demand function. Dependent variable: lns

	(1) Tobit	(2) IV Tobit	(3) IV Tobit
lnY	-1.39**	-3.45***	-3.296***
	(-2.05)	(-2.89)	(-2.81)
lnB	-3.55***	-3.58***	-3.733***
	(-3.23)	(-3.19)	(-3.39)
$lnpop$	0.88*	2.15***	2.011**
	(1.73)	(2.71)	(2.59)
$lndist$	1.83*	2.22**	2.253*
	(1.75)	(2.02)	(2.04)
isl	-24.76***	-22.1***	-22.61***
	(-4.15)	(-3.54)	(-3.71)
$lowcost$	5.2***	5.97***	6.47***
	(3.71)	(4.01)	(4.47)
$motway$	-4.36**	-5.01**	-5.197**
	(-2.04)	(-2.25)	(-2.38)
$railway$	-3.34*	-2.81	-2.632
	(-1.81)	(-1.47)	(-1.41)
$eind$	2.9**	2.46**	2.31*
	(2.54)	(2.02)	(1.91)
$tourism$	-0.000068	0.0004	0.0005
	(-0.2)	(1.04)	(1.31)
$lnMad$	1.49	0.80	0.880
	(0.66)	(0.34)	(0.39)
$lnBCN$	2.09*	2.18*	2.090*
	(1.78)	(1.83)	(1.91)
Constant	2.37	6.67	7.79
	(-0.71)	(0.5)	(0.6)
Times dummies	Included	Included	Included
Regional dummies	Included	Included	Included
Wald test of exogeneity (χ^2_1)		4.71**	3.56**
Test of instruments			
J statistic (χ^2_2)		0.55	0.37
p-value		0.76	0.83
N	207	207	207

t statistics in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 4: Elasticities of unit public funds for different values of some relevant variables

	5% percentile	50% percentile	95% percentile
Total aircraft movements	-2.391***	-1.99***	-1.125***
Y	(-3.73)	(-4.13)	(-19.22)
Public budget	-3.22***	-2.76***	-1.05*
B	(-2.91)	(-2.95)	(1.67)
Population	-1.87***	-2.64***	-2.94***
pop	(-5.23)	(-2.97)	(-2.76)
Percentage of lowcost passengers	-2.21***	-2.65***	-3.07***
lowcost	(-3.08)	(-2.97)	(-2.87)
Density of motorways	-3.43***	-2.56***	-0.16**
motway	(-2.89)	(-2.94)	(-2.52)
Industrial specialization index	-2.41***	-2.61***	-2.98***
eind	(-2.85)	(-2.95)	(-3.02)

t statistics in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 5: Estimates of the airline's mark-ups for each airport

Airport	Mark-up	[95% Conf.	Interval]
Albacete	1.58***	0.51	2.66
Alicante	0.31***	0.09	0.52
Almería	0.16	-0.04	0.36
Asturias	0.54***	0.17	0.92
Badajoz	2.17***	0.70	3.64
Burgos	1.69***	0.54	2.83
A Coruña	0.76***	0.24	1.27
Fuerteventura	0.34***	0.11	0.57
Girona	2.20***	0.74	3.65
El Hierro	2.58***	0.88	4.27
Ibiza	0.33***	0.1	0.56
Lanzarote	0.33***	0.12	0.55
La Palma	0.83***	0.28	1.38
La Rioja	2.1***	0.67	3.53
La Gomera	3.4***	1.05	5.79
León	1.56***	0.5	2.63
Gran Canaria	0.34***	0.11	0.57
Madrid	0.32**	0.03	0.61
Menorca	0.46***	0.5	0.78
Málaga	0.015	-0.015	0.045
Melilla	3.28***	1.05	5.51
Palma de Mallorca	0.51***	0.16	0.85
Pamplona	0.58*	-0.07	1.23
Reus	2.35***	0.75	3.96
Salamanca	1.26***	0.47	2.05
Murcia	2.35***	0.75	3.96
San Sebastián	0.58*	-0.06	1.23
Tenerife Sur	0.30***	0.09	0.51
Tenerife Norte	0.44***	0.14	0.74
Santander	1.36***	0.44	2.29
Santiago	0.49***	0.15	0.82
Valencia	0.34***	0.11	0.57
Valladolid	1.13***	0.36	1.91
Vigo	0.58***	0.19	0.98
Vitoria	1.75**	0.40	3.11
Zaragoza	1.19***	0.38	1.99

t statistics in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$